

Environmental Approaches to the Prehistory of the North

William Fitzhugh

*Associate Curator of North American Archeology,
Smithsonian Institution, Washington, D. C. 20560*

ABSTRACT

Archeological research in the Arctic and Subarctic has expanded recently to include a wide variety of scientific disciplines including geology, ecology, and palynology. The use of these approaches is discussed in relation to an archeological project being conducted on the central Labrador coast where a 5500 year record of human occupation has been uncovered. This interesting approach to archeology has led to a better understanding of man's relationship to the North.

Serious anthropology in the Arctic began less than 100 years ago when Frans Boas made his historic visit to the Central Eskimo in 1883. Archeological investigations of Eskimo prehistory, however, did not begin until the pioneering research of Therkel Mathiassen as part of the Danish Fifth Thule expeditions in 1924. Mathiassen's work, and that of other archeologists following him, grew out of desire to link the living peoples of the Canadian and Greenland Arctic to old living sites and legends of an earlier race, called Tunnits. These sites were semisubterranean sod and earth houses with whalebone-supported roofs, and they were frequently associated with stone burial cairns. The numerous bone artifacts and debris found in these settlements indicated that unlike their descendants these earlier Eskimos were whale

hunters, but otherwise they had an economy and material culture very similar to that of their ethnographic descendants. Excavation and interpretation of the early Eskimo culture, later known as Thule culture, could be accomplished by reference to the well-known historic Eskimo culture. Indeed, the archeologist's task was greatly simplified by his Eskimo digging companions, who were frequently able to name and identify the function of excavated tools—not, however, without frequent aspersion to the parochialism and backward styles of their forebears.

This ethnographic approach to Eskimo archeology persisted as the only recognized system of interpretation until a different form of prehistoric culture was discovered which preceded Thule culture and whose remains consisted mainly of minute flaked stone implements of an Old World mesolithic character. The contrast between Dorset and Thule culture

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was marked. Dorset people did not hunt whales; nor did they appear to use dog traction, covered earth houses or cairn burial. Their sites were on open, exposed locations, and the forms of their harpoons and lances were quite distinct from Thule implements. In fact, the archeologist's Eskimo companions were as puzzled as he was about the nature of this strange new mini-culture. Eskimo working with archeologist Louis Giddings in Alaska decided that the Dorset people and their Denbigh predecessors must have been a race of midgets, so small and seemingly ineffectual were their precisely flaked stone implements. Yet their face masks and skeletalized art work grippingly portrayed a psyche and world view riddled with powerful, mysterious demons and malignant spirits.

Not long after the discovery of Dorset culture archeologists uncovered the traces of a still earlier people of the Eastern Arctic. Prosaically dubbed "Pre-Dorset," this culture was clearly descended from an earlier microlithic culture in Alaska and appeared to represent the earliest Eskimo occupation of the Eastern Arctic. Their arrival in the east about 4000 years ago was equally dramatic as the later migration of Thule culture, for within a few centuries they had spread from Alaska east to northern Greenland and Labrador. While Pre-Dorset people were well adapted to the full range of arctic conditions, their economy was based on a greater degree of land hunting of caribou and muskox than were the later Eskimo cultures. In general their culture was similar to that of the Dorset people, into which Pre-Dorset evolved around 1000 B.C. without major new influence from the Western Arctic or the Canadian forests to the south. These 2 early cultures compose a single historical continuum known as the Paleo-Eskimo tradition beginning as early as 2200 B.C. and persisting until the arrival of the Thule migrants with their dogsleds and whaling harpoons around A.D. 1000. Thereafter, Dorset culture disappears with the exception of possible acculturated

enclaves in Southampton Island and Hudson Strait.

The historical events and environmental conditions surrounding this cultural trilogy in the Eastern Arctic poses a great number of questions of interest to northern archaeologists. In fact, the uniqueness of cultural adaptations in the Arctic zone creates topics of general theoretical interest for anthropologists throughout the world. The focal point of the problem is, of course, the same one that has always stimulated interest in Eskimo culture, beginning with Frobisher's encounter with Baffin Island Eskimos in 1577 and which reached such a near fever-pitch following 19th century Arctic explorations of Franklin, Kane, Hall, Greeley and others—namely, what motivated man to inhabit this climatically fierce region and how did he sustain life in the face of this hardship? For the archeologist, the query went into more detail, however. The list of questions includes: What were the effects of climatic cooling and warming on northern terrestrial and marine mammals? Do population declines occur periodically which might affect human subsistence? What are the structural differences between the northern land and sea ecosystems which influence human adaptations? These more theoretical questions were followed by a host of specific problems, involving the origins of Pre-Dorset, Dorset, and Thule cultures, their distributions and variability.

Answers to these questions were not forthcoming from studies of Eskimo ethnography and mythology, which had supplied extensive detail for early reconstruction of Thule culture. The discovery of a 3000-year Paleo-Eskimo tradition was a radical new development in Eastern Arctic prehistory which required a totally new approach to archeological interpretation. Partly in response to this challenge a new type of research is being conducted in the Eastern Arctic. As a result of the more impoverished physical remains of the Paleo-Eskimo sites this work draws much of its support from

techniques of the natural sciences including biology, animal behavior, oceanography, meteorology, and geology.

While not dismissing the importance of Eskimo ethnography, the new strategy emphasizes a conjunctive approach in which culture and environment are studied as interrelated variables on the assumption that human populations exist within a geographic and environmental system and that changes in the system are reflected in various aspects of a culture's adaptation. In a harsh environment, such as the Arctic, the physical restraint on cultural expression is relatively strong. The very nature of human groups, however, requires the consideration of cultural tradition and history into this scheme. A simple deterministic approach to environmental control of culture cannot be maintained. Thus the task of the archeologist is to determine the weighting of various environmental and historical factors in the explanation and cultural reconstruction of prehistory. It is this dualism between biophysical conditions and socio-cultural expression that makes the search for the reality of prehistory so elusive to archeologists. Therefore, for the purposes of this paper it will be expedient to consider only those aspects of northern prehistory in which the role of natural science is paramount. We proceed with the discussion of 6 major types of analysis which can be used to elucidate environmental relationships of some of the early Eskimo and Indian occupants of the Arctic and Subarctic.

Geological Analysis

Much of the information available to the archeologist comes through investigation of the physical environment. In order to reconstruct the prehistoric landscape of 500, 2000, or 4000 years ago, one must understand the physical and biological processes that have modified the land. In the north 2 factors—climatic change and post-glacial geographic modification—have been primarily responsible for these changes.

During the last glaciation it is estimated that an ice sheet approximately 1 mile thick developed on the Canadian Shield and the Labrador-Quebec plateau. The tremendous weight of this ice resulted in plastic deformation of the earth's crust. Following deglaciation the land "floated" back to its original position, and the highest main terraces and lowest limit of glacial erratic boulders give some indication of the extent of glacial depression. Northeastern Hudson Bay was depressed between 500–800 ft, while in Central Labrador it varied from 600 ft on the interior to 250 ft on the coast. Farther south, in the Gulf of St. Lawrence and Upper Great Lakes, the greater thickness of ice buildup is registered by upper marine limits of nearly 1000 ft.

In areas of sandy deposits, relic beach lines and terraces provide a relative chronology of post-glacial uplift from the highest formations to the lowest, contemporary ones. By radiocarbon dating fossil shells, peat, or driftwood contained in these beachlines, it is possible to construct an absolute isostatic curve for the post-glacial period. In all areas where this has been done the curve is found to be generally logarithmic, with an initial rapid period of adjustment of up to 25–40 ft per century in the first few millennia after deglaciation and thereafter slowing to a current rate of less than 1 ft per century. Even today uplift is perceptible to Labrador fishermen who remark on the shoaling of harbors which no longer accommodate their boats as they did a generation or two earlier.

Along the sea coast uplift can be useful to the archeologist in several ways. Most immediately, the sequence of beachlines provides a relative timescale for the chronological ordering of prehistoric settlements found associated with active beaches in the past. Older sites must be confined to the upper beaches and terraces while younger sites are generally found along the more recent formations. Since most cultures occupying the maritime regions of the Subarctic and

Arctic were active seafarers, relative elevations have proven to be valuable chronological indicators, and detailed chronologies have been developed for the uplifted Arctic regions of Baltic and North Norway, Greenland, and the Eastern and Central Arctic. Unfortunately, coastal submergence has occurred in the Northern Hemisphere in the regions immediately adjacent to uplifted zones, such as in Alaska, New England, and northern Europe. This makes it difficult to relate sites on the northern beaches to contemporary cultural and chronological developments in southern coastal zones where several thousand years of prehistory lie submerged.

In the Eastern Arctic the most complete cultural sequence so far developed comes from the Igloodik area of northern Fox Basin. Here, Jorgen Meldgaard of the National Museum of Denmark has identified a series of Eskimo cultures beginning with Pre-Dorset settlers of about 2000 B.C. located on the upper beachlines. Later sites are found on successively lower beach levels, documenting the transition into Dorset culture along the 800 B.C. beaches and continuing through the arrival of Thule cultures and subsequent developments down to the present day. Since Igloodik is an area of relatively slight vertical relief, these sequential settlements are horizontally separated from each other and there is relatively little contamination of earlier settlements by those immediately following. As a result, Meldgaard feels confident in studying the evolution of tool types from house to house and believes that it is occasionally possible to identify stylistic developments within single generations, a substantial improvement over the precision of radiocarbon dating! Unfortunately, the lack of preservation of the stylistically most sensitive bone tools do not allow this approach to be applied with equal success in many other areas of the North. Other areas where geological dating has facilitated relative archeological dating include the Cape Krusenstern sequence developed by Louis Giddings in Alaska and the Hamil-

ton Inlet chronology developed by the author for the central coast of Labrador.

Precise control of uplift information is not often available for an area in which an archeologist is working. This was the case in Hamilton Inlet when archeological work began in 1968. Therefore a major part of the continuing archeological program in this area has involved collecting geological data pertinent to archeological problems. The elevation of raised terraces and beachlines was recorded, and datable samples, such as marine shells and bones from stranded whales found associated with these fossil shorelines, were submitted for radiometric dating.

This research has resulted in 2 preliminary uplift curves (fig. 1) for the Hamilton Inlet region. Normally 1 curve would adequately describe uplift conditions for a given region. However, in Hamilton Inlet the maximum limit of marine submergence in western Lake Melville was found to be nearly 500 ft while on the outer coast the marine limit is only 250 ft. The difference appears to be a result of greater ice build-up toward the center of ice dispersal in the Labrador-Quebec interior, while the ice sheet remained thinner at the coast due to the moderating influence of the ocean. An inspection of the 2 curves reveals a dramatic difference between western Lake Melville and the outer coast 150 miles to the east. Terraces on the outer coast at 40-55-ft elevation were available for cultural occupation by 5500 years ago, while elevations with comparable dates in North West River now lie over 100 ft above sea level. Therefore, there is greater potential for vertical separation of archeological sites belonging to different cultural periods on the interior.

One of the most intriguing aspects of the geological investigation of Hamilton Inlet results from the reported existence of a few fossil whale skeletons north of Groswater Bay and near Cape Harrison where they are claimed to lie at elevations nearly 1000 ft above sea level. If the elevation of these whale fossils is correct they are far above the most recent post-glacial marine limit, and they pose

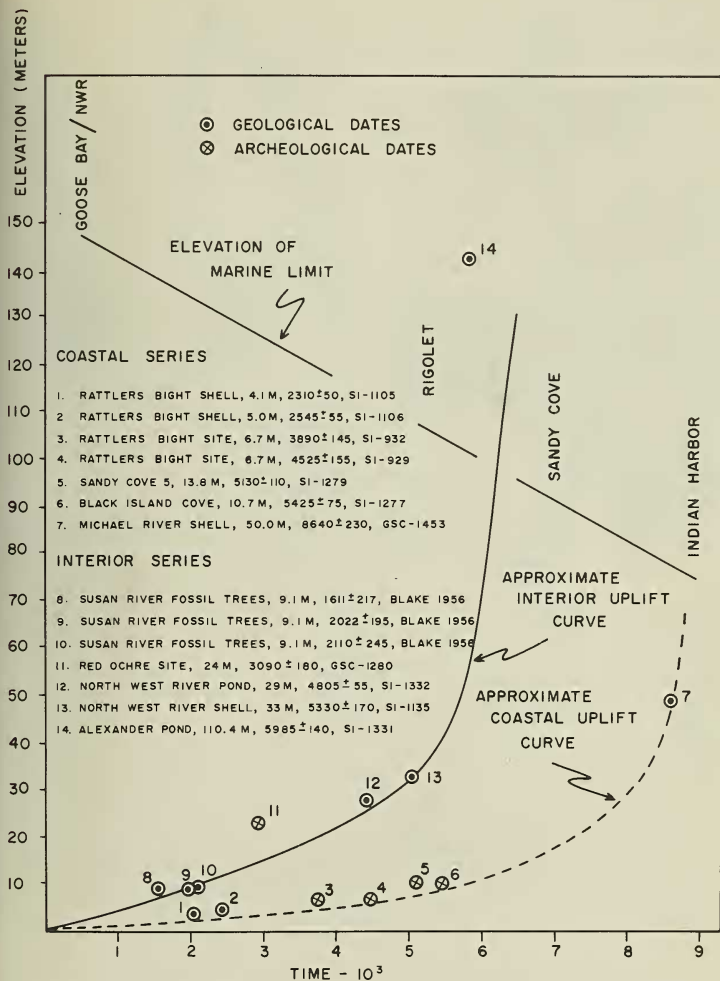


Fig. 1.—Uplift curves for the Hamilton Inlet region of Labrador. Two curves are presented: one (solid curve) for the interior Goose Bay region in western Lake Melville and another (dashed line) for the outer coastal zone. The maximum elevation of the marine limit is indicated at the top.

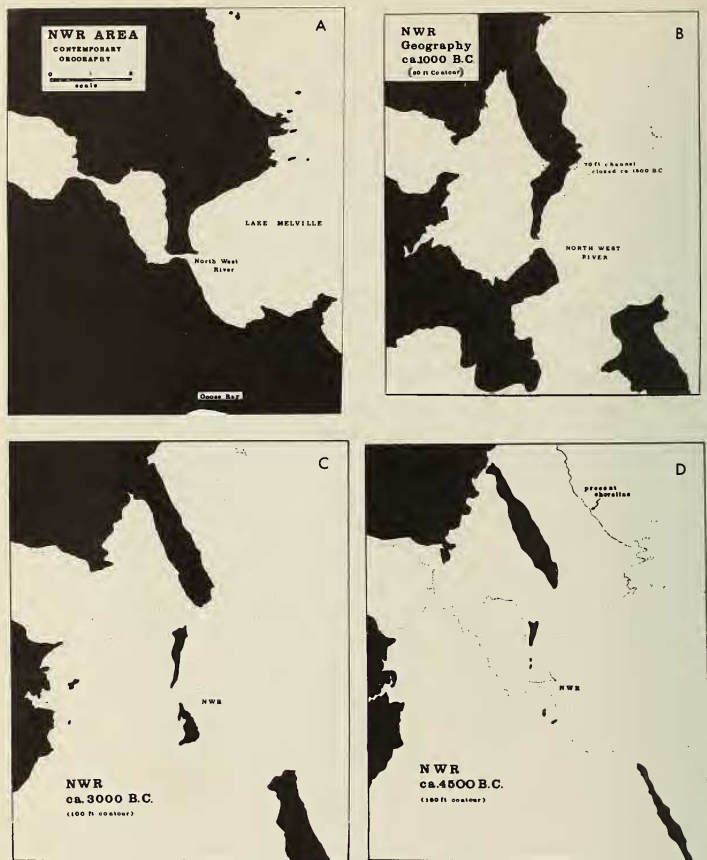


Fig. 2.—Geographic changes in the North West River region, western Lake Melville, during the past 6500 years. The most important changes in terms of human occupation took place about 3500 years ago when uplift closed the island passes along the North West River moraine and created the present exit of the Naskapi River at North West River.

a unique challenge to geological interpretation. At present our understanding of Pleistocene events in Labrador does not permit glaciation of the extent that could result in land submergence on the order of 1000 ft. Additionally, current

evidence indicates that all but possibly the highest mountains of norther Labrador have been completely overridden by the ice sheet in the past glaciation. The presence of stranded whales at the reported elevation would thus require

substantial revision of current geological thought, including the existence of formerly more extensive glaciation and the occurrence of nunataks (ice-free summits) during the most recent glacial maxima. Nunataks have been suggested as possibilities for the 4-5000-ft-high Tornagat peaks of northern Labrador. To find them at 1000-ft elevations in central Labrador would be unique indeed.

Paleo-Geography

The uplift curve is important to the archeologist for more than relative dating of prehistoric sites. It is an important tool in paleo-geographic studies and interpretation of settlement pattern shifts through time. We have noted that landforms have changed far more significantly on the interior than they have on the coast during the early period of human occupancy of central Labrador about 4000 B.C. At this time uplift in the North West River area may have been as great as 5-10 ft per century, enough to change landforms significantly during a man's lifetime. As new land merged, old living sites were abandoned and settlements shifted to new sites with more favorable circumstances. No sites have been found dating to this period in North West River because it was at that time a small offshore island in a large marine estuary (fig. 2a). We may assume that these sites are present in the Naskapi River Valley at elevations above 150 ft. By 1500 B.C. the land had emerged enough to bring the North West River recessional moraine out of the sea near the 70-ft topographic contour (fig. 2b). At this time there were 2 exits for the Naskapi River into Lake Melville, one via the present channel and a second a few miles to the north. As uplift continued the northern channel closed (fig. 2c) and human movement between the coast and the interior for the next 3500 years became channeled through the present debauchment (fig. 2d).

Archeological data follows this geological reconstruction very closely (fig. 3). No sites have been found at North West

River above the 78-ft beaches when it was an island. However, initial occupation began shortly after 1500 B.C. on the 60-70-ft terraces. As the land continued to rise the river cut down through the morainal sands, producing successively lower terraces for occupation by later Indian cultures. This process has enabled a detailed chronological sequence of cultures to be constructed for the area—this has been substantiated independently by typological and radiocarbon dating. Although the uplift on the outer coast is less and does not provide such precise vertical zonation, it is possible to use the same techniques of relative archaeological dating and geographic analysis in these areas. Here, however, there were no large rivers to provide reworked sand deposits for persistent settlement at a single locale through time. Rather, uplift changes resulted in extensive lateral displacement of archeological sites to new harbors and marine terraces as they emerged from the sea and became more desirable than those harbors with perched terraces and rock-strewn entrances.

Physical Analysis

Another type of analysis which has proven useful in archeological interpretation in central Labrador involves mineralogical and petrographic identification of lithic raw materials used in the stone tool industry of the early Indians and Eskimos. The Canadian Shield, which is the basic geological province encompassing much of northeastern Canada, is composed of granites and gneisses and other igneous and metamorphosed rocks of great age. Lacking sedimentary deposits, it is an area devoid of cherty rocks with concoidal fracture which were of main importance to man.

Central Labrador does have some remnant metamorphosed sedimentary and igneous beds which contain useful material, but the outcrops are small and localized in nature and are extremely variable in color, texture, and other prop-

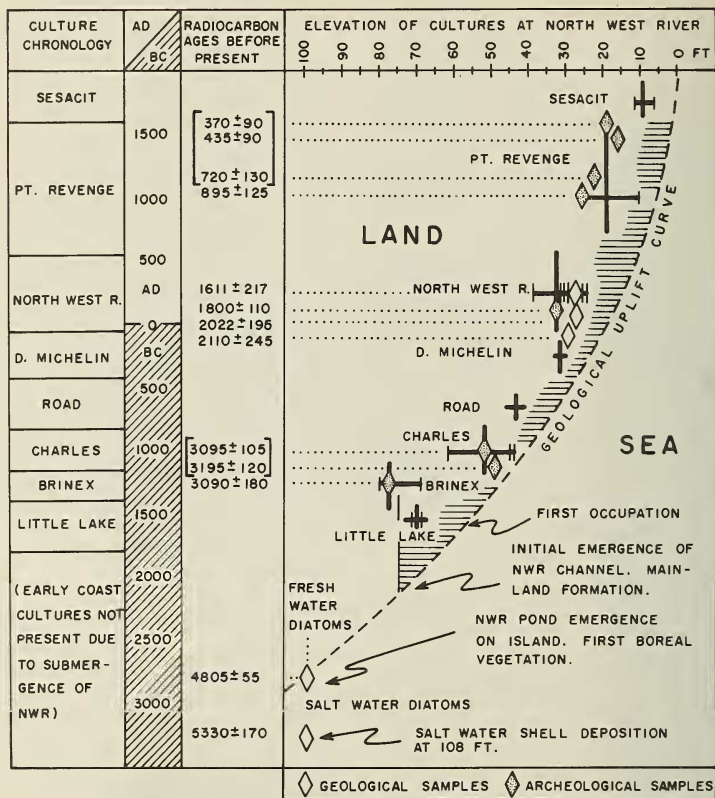


Fig. 3.—Archeological sequence at North Wester River, Labrador. This sequence represents the last 3000 years of a longer 5500-year culture history which has been defined for Hamilton Inlet. The cultural chronology at North West River clearly reflects the relationship between prehistoric sites, their elevation above sea level, and radiocarbon dates. Geological information includes fossil sea shells and salt water diatoms found in 5000-year-old uplifted sediments at approximately 100-foot elevations. More recent samples of fossil trees in the 2000-year range may indicate either fresh or salt water deposition.

erties. No single source was of domiant importance such that all prehistoric peoples used it; rather each culture seems to have found and utilized different quarries. Their choice of raw materials thus indicates a cultural preference which is replicated repeatedly in different sites

belonging to a particular culture group. For instance, one group may consistently choose to use a commonly available material such as quartzite, available in the glacial and beach deposits, while a subsequent group preferred a high quality chert of a diagnostic type. A third might

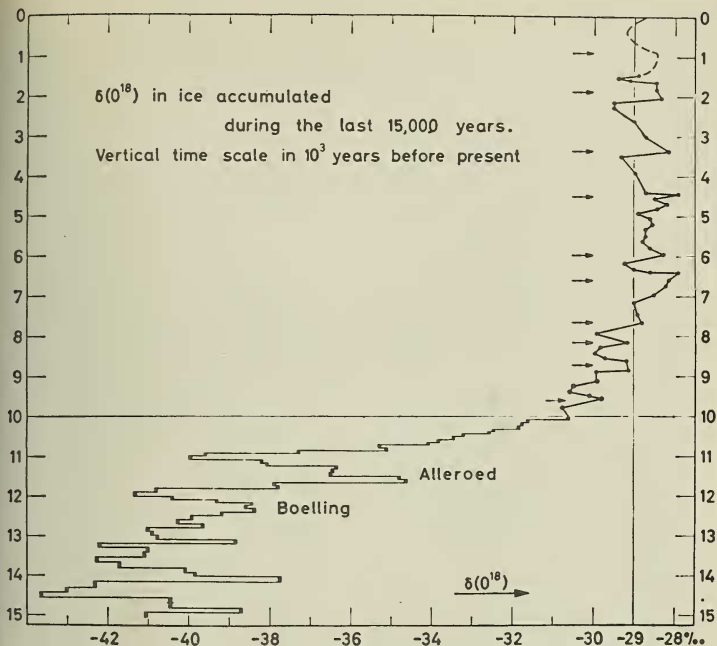


Fig. 4.—Climatic variations in the Camp Century, Greenland, ice core over the past 15,000 years, reflected by oxygen isotope variations. The data points in the upper part of the curve represent time periods of from 25 to 50 years. The step curve in the lower portion represents a continuous sequence of measured samples, each extending over approximately 100 years. (After Dansgaard, *et al.* 1969, *Science* 199(3903): fig. 4).

choose an exotic material available only from distant sources and for which extensive travel or trade must have occurred. In this way, not only are individual cultures characterized by a certain raw material complex, but the geographic origins of these materials, if they can be precisely defined, gives an indication of the extent of movement or external contacts of a particular group. For this reason archeologists in the North and elsewhere have recently become interested in vigorous scientific methods of identifying raw materials found in archeological sites.

One of the raw materials which was

of special importance for interpreting cultural movements is a distinctive translucent, granular stone commonly found in coastal archeological sites and rarely found on the interior. This material, known as Ramah chert, has a geological origin in northern Labrador where it outcrops as a thin band in a sedimentary series far north of the treeline on the northern coast of Labrador, 350 mi from Hamilton Inlet.

The presence of Ramah chert in archeological sites in central Labrador and further south indicates a remarkably long-distance trade network which seems to have been most extensive in the Mari-

time Archaic period about 2000 B.C., a time in which points of this material were traded south as far as southern New England. That such a trade net existed along the coast but did not penetrate the interior implies a maritime orientation with good navigational capabilities, extensive contact, and cultural and probably linguistic homogeneity between the participating cultures from northern Labrador to southern Maine. The use of Ramah chert in central Labrador and its southern dispersion ceases abruptly after 1800 B.C., coincident with the disappearance of Maritime Archaic culture from the central coast of Labrador and the appearance of Pre-Dorset Eskimos in northern Labrador in the vicinity of the Ramah chert beds. Here we have an example of the importance of raw material distributions as an indicator of shifts in cultural geography. Following this early period Ramah chert is not extensively used until Indian cultures again develop a coastal adaptation following until the appearance of the Point Revenge complex begins about 500 A.D. During the intervening period Indian cultures rarely utilized the coast except for brief summer sojourns, and their activities apparently did not extend north to the Ramah beds. This is documented by the lack of coastal raw materials in their tool inventories and the absence of coastal settlements.

This type of interpretation from lithic materials can be made only if it is possible to develop exact methods of identifying lithic material from an archeological site and its purported geological parent. This has proved difficult owing to variability within rocks from one geological source location. However, a number of techniques, including X-ray diffraction and fluorescence, neutron activation, electron microprobe, and various mineralogical and petrographic methods, have been used with results which range from excellent to poor, depending on the characteristics of the material and the state of the science. Research in this area is still in a developmental stage, but promising results have been obtained from

neutron activation of obsidians and cherts. The best results have come from metallurgical analyses of Near Eastern metal ore bodies. In some cases, however, it appears that simple petrographic and visual studies are sufficient for accurately identifying the more distinctive materials. These techniques have proven as successful for identifying Ramah chert as preliminary neutron activation.

Environmental Models

The best source of data for reconstructing past environments often comes from archeological deposits where any material reflects human agency and cultural activities. Unfortunately, subarctic archeological sites are habitually devoid of preserved organic material of any sort due to the acidic soils of the Canadian Shield and the lack of extensive terrestrial deposits. Under these limitations the archeologist is forced to adopt a game plan which relies on secondary information sources. Using the ethnographic analogy of recent Indian and Eskimo activities and the local setting of a site, it is generally possible to determine the main purpose of a camp. One can be fairly certain that river mouth sites were fishing camps; inland camps were more likely caribou hunting stations; and sites found on exposed regions of the coast were probably seal and sea bird hunting camps. Combining this information with contemporary animal distribution one can develop a model which can be projected into the past with some assurance, providing major environmental changes have not occurred. However, even with environmental and climatic change this technique of "using the present as a key to the past" provides an archeologist with workable environmental models and hypotheses. For, if he knows the factors governing present animal distributions and the effects of climatic change on the environment, he can reasonably accurately predict the probable effects of environmental shifts on these species. Correlations can then be developed with cultural distributions to see if their shifts

through time correspond with these in the natural environment.

Two examples demonstrate the use of environmental modeling in archeological research in Labrador and Hudson Bay. One of the major problems is the variability in the Indian adaptations from the central Labrador region. Here, initial Indian occupation began with the Maritime Archaic tradition with a strong coastal orientation between 5500–3800 years ago. Following this long period of cultural stability came 2000 years of cultural instability in which a number of different cultures occupied both the interior and coast, succeeding each other at approximately 500-year intervals. There is no evidence of in-place development of these groups, and they are interpreted as new introductions of people and ideas from the south. After 500 A.D. the Point Revenge culture appeared and continued to develop until historic times with a strong maritime orientation. The record thus indicated a long initial period of cultural stability within a maritime adaptation followed by a several-thousand-year period of cultural instability and replacement with only limited coastal adaptation. The last culture period is again one of stability with a maritime adaptation.

The description of culture history such as this is only the beginning of archeological interpretation. The immediate question that arose from this sequence involved an explanation of the various periods of continuity and discontinuity in the record. Was this the result of idiosyncratic cultural events or of more general effects of environmental variables? To determine this an investigation of present day ecology of both marine and terrestrial environments was undertaken with specific reference to mammals of importance to man and the factors that govern their distribution and population structure.

Structural Ecology

The northern terrestrial environment is a relatively species-poor ecosystem

characterized by a simple food chain and trophic structure. It is an unstable system subject to periodic and strong perturbation by fire and winter icing, both of which may precipitate population declines of man's basic resource, the caribou. Since caribou are herbivores adapted to lichen grazing in the boreal forest and tundra, any alteration of the lichen fields either by fire or winter glaze storms can result in population crashes or migration shifts. If these drops occur during a time when human populations are near carrying capacity, starvation is likely to occur. Ethnographic documentation provides abundant support to this cycle of events in northern Labrador and Quebec.

In terms of climatic variation, it appears that forest fires produced largely by lightning are more prevalent during warm, dry summers, while cool, damp summers have a lower pyrotechnic index. Correspondingly, cold dry winters do not present the severe icing conditions that cause caribou starvation if occasionally rainstorms strike the winter feeding grounds. Speaking only in terms of fire and icing (excluding predation), one would expect caribou herds to increase in cool climatic periods and to fall in warm periods. In fact, historical information on herd sizes gives some support to this model with caribou peaks in the cool periods around 1900 and 1960–70 and with lows in the warm period between 1915–1955. Data on caribou herds in the Central Barren Grounds and Alaska suggest similar systematic correlations.

Marine ecosystems are not subject to the same inherent instability of northern terrestrial ecosystems. The marine environment is species-rich and most animals have a broad food base. Food chains are complex and population oscillations are not great. Here, sea ice is the primary ecological determinant, and its distribution and nature affect not only the abundance of marine mammals such as seals, walrus, and whales, but more importantly, their availability to man. In particular, stormy weather may be a significant factor in the ability of a hunter to

reach the game. In the marine ecosystem faunal shifts appear to occur more gradually, with less population oscillation than is characteristic for northern land mammals, and geographic shifts due to shifting climate and ice conditions are both gradual and directional. This enables the marine-oriented hunter to better predict the availability of game than is possible on the interior. Thus, cooling climates result in southern movement of arctic marine mammals down the Labrador coast coincident with a retreat of the northern forest limit. Warming conditions reverse this situation.

In short, we have presented an environmental model in which interior cultures have a potentiality for instability and periodic extinction, which is not a dominant structural component of maritime adapted cultures. Furthermore, there is a strong possibility that interior adaptations are more unstable in warm climate periods than in cool periods. However, during warm periods the coast offers a relatively diverse and stable resource base at a time when the forest limit is likely to extend further north providing shelter and firewood for Indian cultures.

Climatic and Vegetation History

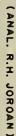
It remains, then, to determine climatic events in relation to the culture history developed for Hamilton Inlet. Fig. 4 presents an oxygen isotope analysis of an ice core taken from Camp Century, Greenland. The results show a remarkably precise temperature determination for the past 15,000 years and are in agreement with temperature data based on medieval historical records and North European pollen studies. It will be seen that the peak temperature periods fall during the times of strongest cultural continuity for Indian coastal adaptations in central Labrador. Furthermore, the cold spells at 1800 B.C., 500 B.C., and 1500 A.D. correspond to southern movements of Eskimos in Labrador. These are times when one might expect southern forest

shifts and Indian retreats from the coastal zones.

Similar results are seen in the analysis of pollen cores taken from the Hamilton Inlet region as part of the Smithsonian Institution's Hamilton Inlet Project. The core from Alexander Lake, near Goose Bay (fig. 5), contains a 6000-year record of post-glacial vegetation changes beginning with deglaciation around 6500 B.P. Tundra vegetation, represented by high birch, alder, willow, grass, and sedge, becomes established by 6000 B.P. and lasts until the dramatic influx of the spruce forest about 4500 B.P. Thereafter the forest composition does not register climatic events because the sample location is well within the main boreal forest limits. Charcoal counts indicate that fires have been an important part of both the tundra and boreal periods, with a major fire horizon in the tundra zone about 5500 B.P. and subsequent peak fire periods in the peak boreal period, ca. 5000-4000 B.P., followed by a drop and then gradual increase during the past 1500 years. A second pollen core (fig. 6) from Sandy Cove Pond, located on the forest-tundra boundary in outer Hamilton Inlet, is more sensitive to climatic events. It has a profile showing an initial and very brief period of tundra beginning about 5000 B.P. followed by spruce forest invasion ca. 4500 B.P. Here, however, at the forest edge, the spruce record shows considerable variation suggesting a forest maximum between 4500-3500 B.P. and declines between ca. 3500 and ca. 2000 B.P. with an intermediate cool period. The charcoal frequency reinforces the spruce curves by indicating fire peaks corresponding to the spruce maxima. Finally, the initial date of revegetation at ca. 5000 B.P. is remarkably late in this coastal core and suggests that final deglaciation of this region was far later than previously thought.

The pollen data from Hamilton Inlet provide important correlations between the cultural sequence of Indian and Eskimo settlement and adaptation types and the environmental models for caribou

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ecology. First, it will be noted that ice blocked the occupation of the central Labrador interior until nearly 6000 B.P. and perhaps persisted in the coastal regions until the end of the hypsithermal at 4500 B.P. The first known occupation of this region was by Indians who arrived about the same time as the introduction of the boreal forest and spread north with the forest to its northern limit in northern Labrador. The important maritime focus of this early culture may result partially from its being a more stable adaptation during this peak period of forest fire (and inferentially, winter icing) activity, which declines during the cooler period following 3800 B.P. The intermediate period between 3800-1500 B.P. is cooler, and the forest seems to have retreated somewhat from the outer coast. Perhaps this, as well as improved hunting conditions on the interior, resulted in the limited use of the coast by Indians during this period. The appearance of Dorset Eskimo culture from northern Labrador between 2700-2300 B.P. was another important factor. Following the disappearance of Dorset culture and climatic warming beginning around 1500 B.P. Indians of the Point Revenge complex recolonized the coast and moved into northern Labrador with the northern forest expansion of the Climatic Optimum. It is at this time that Ramah chert again appears in the tool industry as it did in the northern expansion of Maritime Archaic around 4500 B.P. A final cooling period around 400 years ago coincident with the impetus for European trade, resulted in the southern expansion of Labrador Eskimo into central Labrador. This movement displaced the protohistoric Indian peoples into the interior, where they still exist today, deprived of their traditional summer coastal hunting and fishing grounds.

It would thus appear that cultural movements in central Labrador have resulted from a combination of environmental and historical conditions. There has been a strong tendency for interior Indian cultures throughout prehistory to

adopt summer coastal adaptations. During warm periods these adaptations intensified and spread to the north, perhaps at the expense of Eskimo cultures. Any cooling period, however, especially if it resulted in retreat of the forest from the coast, has caused Indians to decrease use of the coast and to concentrate on interior hunting. That interior caribou hunting was insufficient for long-term cultural stability is suggested by the discontinuity of interior cultures of these cool periods. These are times when Eskimo cultures often moved south, introducing cultural and historical factors into the already complex relationships governing culture distributions and developments.

Conclusion

The foregoing discussion has presented a few of the more important scientific approaches to northern archeology. These techniques are by no means restricted to the study of arctic and sub-arctic archeology but have wide applicability in other areas. Archeologists are increasingly turning to these methods for information to increase the understanding of culture history and especially to investigate possible causes of culture change. In this process many other techniques are being used as well. Satellite photography is available today which permits extremely detailed environmental analyses, and in the Arctic where ice conditions are important in the distribution of animals and man they are proving extremely valuable sources of information. The development of new scientific techniques and the advancing ability of the archeologist to properly interpret the results of these analyses will continue to be a well-spring of future research in prehistory. In the future, archeology will only prosper through an increasingly integrated position between the social and natural sciences, one which mediates between the extremes of nihilistic historical particularism and mechanistic environmental causation.